1.5 A Step-Down DC/DC Converter with Built-in Inductor

FEATURES

- **Built-in inductor and transistors**
- **Operating Input Voltage Range**: 2.7 V ~ 6.5 V
- **Output Voltage Range**: 0.8 V ~ 3.6 V
- **Output Voltage Error**: ±2%
- **Output Current**: 1500 mA
- **High Efficiency**: 92% (V_{IN} = 5.0 V, V_{OUT} = 3.3V)
- **Oscillation Frequency**: 3.0 MHz
- **Maximum Duty Cycle**: 100%
- **Operating Modes**: PWM, PWM/PFM auto select
- **Functions: Chip Enable,** Built-in Current Limit, High Speed Load Capacitor Discharge, Soft start, thermal shutdown
- **Operating Ambient temperature:** -40 ~ +85^{0}C
- **Package: USP-9B01**
- **EU RoHS Compliant, Pb Free**

APPLICATION

- **Mobile Phones**
- **Bluetooth headsets**
- **Digital home appliances**
- **Office automation equipment**
- **Various portable equipment**

DESCRIPTION

The IXD9213/14 series are synchronous step-down DC/DC converters with an inductor and a control IC in one tiny (2.5 x 3.2 x 1.0 mm) package. A stable power supply with an output current of 1500 mA requires only two capacitors connected externally.

Operating voltage range is from 2.7 V to 6.5 V. Output voltage is internally set in a range from 0.8 V to 3.6 V. The device operates at 3.0 MHz switching frequency, and includes 0.14 Ω P-channel switching transistor and 0.10 Ω N-channel transistor for synchronous rectification. The IXD9213 series operate in a fast transient response PWM mode, while IXD9214 series automatically switching between PWM/PFM modes.

An automatic PWM/PFM switching allows fast response to the load changes, low ripple noise, and high efficiency over the full range of loads.

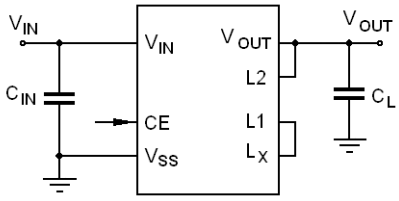
CE pin allows set device into stand-by mode with a current consumption below 1.0 µA.

The built-in Under Voltage Lockout (UVLO) function forces the internal switching transistor OFF when input voltage becomes less than 2.0 V

IXD9213/14 series have a fast soft start function internally set at 0.3 ms (typ).

IXD9213/14 series have also fast load capacitor C_L auto discharge function, which allows fast C_L discharge through switch located between the L_X and V_{SS} pins. When the devices enter stand-by mode, output voltage quickly returns to the V_{SS} level because of this function.

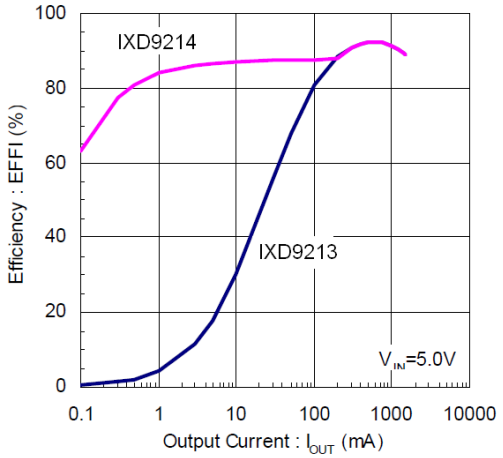
TYPICAL APPLICATION CIRCUIT



Pins L1 – L_X and L2 – V_{OUT} should be connected externally

TYPICAL PERFORMANCE CHARACTERISTIC

Efficiency vs. Output Current (f_{OSC} = 3.0 MHz, V_{OUT} = 3.3 V)



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ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNITS
V_{IN} Pin Voltage	V_{IN}	– 0.3 ~ 6.2	V
L_X Pin Voltage	V_{LX}	– 0.3 ~ V_{IN} + 0.3[1)]	V
V_{OUT} Pin Voltage	V_{OUT}	– 0.3 ~ V_{IN} + 0.3[2)]	V
CE Pin Voltage	V_{CE}	– 0.3 ~ 6.2	V
Lx Pin Current	I_{LX}	4500	mA
Inductor Current at $\Delta T = 40^0C$	I_{LMAX}	1800	mA
Power Dissipation	P_D	1200	mW
Operating Temperature Range	T_{OPR}	– 40 ~ + 85	^0C
Storage Temperature Range	T_{STG}	– 55 ~ +125	^0C

NOTE:

1. L_X pin voltage should not exceed V_{IN} +0.3 V or 6.2 V, which is less.
2. V_{OUT} pin voltage should not exceed V_{IN} +0.3 V or 4.0 V, which is less.

ELECTRICAL OPERATING CHARACTERISTICS

IXD9213/14 series, Ta = 25^0C

PARAMETER		SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT
Operating Voltage Range		V_{IN}		2.7	-	5.5	V	①
Output Voltage		V_{OUT}	$V_{IN} = V_{CE}$ = 5.0 V, I_{OUT} = 30 mA	E-1	E-2	E-3	V	①
Maximum Output Current[1)]		I_{OUT_MAX}	$V_{IN} = V_{CE}$ = C-1 value	1500			mA	①
UVLO Voltage[2)]		V_{UVLO}	$V_{CE} = V_{IN}$, V_{OUT} = 0.6 V	1.35	2.00	2.68	V	③
Supply Current	IXD9213	I_Q	$V_{IN} = V_{CE}$ = 5.0 V, $V_{OUT} = V_{OUT(E)}$ x 1.1 V		400	825	µA	②
	IXD9214				25	40		
Standby Current		I_{STB}	V_{IN} = 5.0 V, V_{CE} = 0 V, $V_{OUT} = V_{OUT(E)}$ x 1.1 V		0	1.0	µA	②
Minimum On-time		t_{ONMIN}	$V_{CE} = V_{IN}$ = C1	E-4	E-5	E-6	ns	
Thermal Shutdown		T_{TSD}			150		^0C	
Thermal Shutdown Hysteresis		T_{TSDH}			30		^0C	
L_X "H" ON Resistance[3)]		R_{LXH}	$V_{IN} = V_{CE}$ = 5.0 V, V_{OUT} = 0.6 V, I_{LX} = 100 mA		0.14	0.28	Ω	④
L_X "L" ON Resistance[4)]		R_{LXL}	$V_{IN} = V_{CE} = V_{OUT(T)}$ x 1.1 V, I_{LX} = 100 mA		0.10	0.20	Ω	
L_X "H" Leakage Current		I_{LXH}	V_{IN} = 5.5 V, $V_{CE} = V_{OUT}$ = 0 V, V_{LX} = 0 V		0.01	1.0	µA	⑤
L_X "L" Leakage Current		I_{LXH}	$V_{IN} = V_{CE}$ = 5.5 V, V_{OUT} = 0 V, V_{LX} = 5.5 V		0.01	30	µA	⑤
Current Limit[5)]		I_{LIM}	V_{OUT} = 0.6 V, ILX increases until oscillations starts	2.5	3.0	4.5	A	⑥
Output Voltage Temperature Characteristics		$\frac{\Delta V_{OUT}}{V_{OUT} * \Delta T_{OPR}}$	$-40^0C \le T_{OPR} \le 85^0C$, I_{OUT} = 30 mA		±100		ppm/^0C	①
CE "H" Voltage		V_{CEH}	V_{OUT} = 0.6 V	0.65		V_{IN}	V	③
CE "L" Voltage		V_{CEL}	V_{OUT} = 0.6 V	0		0.3	V	③
CE "H" Current		I_{ENH}	$V_{IN} = V_{CE}$ = 5.5 V, V_{OUT} = 0 V	-0.1		0.1	µA	⑤
CE "L" Current		I_{ENL}	V_{IN} = 5.5 V, V_{CE} = 0 V, V_{OUT} = 0 V	-0.1		0.1	µA	⑤
Soft-Start Time		t_{SS}		0.10	0.30	0.50	ms	①
Short Protection Threshold Voltage		V_{SHORT}	VOUT voltage, at which Lx goes into "L" state[6)]	0.17	0.27	0.37	V	⑦
C_L Discharge Resistance		R_{CLD}	V_{CE} = 0, V_{OUT} = 4.0 V	50	210	300	Ω	⑧
Inductance Value		L	Test frequency 1 MHz		0.5		µH	
Inductor Current Maximum		I_{LMAX}	$\Delta T = 40^0C$		1800		mA	

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ELECTRICAL OPERATING CHARACTERISTICS (CONTINUED)

NOTE:
Test conditions: Unless otherwise stated, $V_{IN} = V_{CE} = 5.0$ V, $V_{OUT\ (E)}$ = Nominal Voltage.

1) When the difference between the input and the output is so low that duty cycle becomes equal 100%, internal control circuit will keep P-channel transistor in on state, disregard to the output current value. If load current increases further from this state, output voltage will decrease because of P-channel transistor ON resistance.
2) Including hysteresis operating voltage range
3) R_{LXH} resistance (Ω) = (V_{IN} - Lx pin measurement voltage) / 100mA
4) R_{LXL} resistance (Ω) = Lx pin measurement voltage) / 100mA; Design target for IXD9214
5) Current limit denotes the level of an inductor peak current
6) "H"= V_{IN} ~ V_{IN} -1.2 V, "L"=+0.1 V ~ -0.1 V

E-TABLES

NOMINAL OUTPUT VOLTAGE	V_{OUT}, (V)			t_{ONMIN}, ns				NOMINAL OUTPUT VOLTAGE	V_{OUT}, (V)			t_{ONMIN}, ns			
	E-1	E-2	E-3	C-1	E-4	E-5	E-6		E-1	E-2	E-3	C-1	E-4	E-5	E-6
$V_{OUT(T)}$	MIN.	TYP.	MAX.	V_{IN}	MIN.	TYP.	MAX.	$V_{OUT(T)}$	MIN.	TYP.	MAX.	V_{IN}	MIN.	TYP.	MAX.
0.80	0.784	0.800	0.816	2.70	71	119	166	2.25	2.205	2.250	2.295	3.75	140	200	260
0.85	0.833	0.850	0.867	2.70	72	121	169	2.30	2.254	2.300	2.346	3.83	140	200	260
0.90	0.882	0.900	0.918	2.70	73	122	171	2.35	2.303	2.350	2.397	3.92	140	200	260
0.95	0.931	0.950	0.969	2.70	74	123	172	2.40	2.352	2.400	2.448	4.00	140	200	260
1.00	0.980	1.000	1.020	2.70	86	123	160	2.45	2.401	2.450	2.499	4.08	140	200	260
1.05	1.029	1.050	1.071	2.70	91	130	169	2.50	2.450	2.500	2.550	4.17	140	200	260
1.10	1.078	1.100	1.122	2.70	95	136	177	2.55	2.499	2.550	2.601	4.25	140	200	260
1.15	1.127	1.150	1.173	2.70	99	142	185	2.60	2.548	2.600	2.652	4.33	140	200	260
1.20	1.176	1.200	1.224	2.70	104	148	193	2.65	2.597	2.650	2.703	4.42	140	200	260
1.25	1.225	1.250	1.275	2.70	108	154	201	2.70	2.646	2.700	2.754	4.50	140	200	260
1.30	1.274	1.300	1.326	2.70	112	160	209	2.75	2.695	2.750	2.805	4.58	140	200	260
1.35	1.323	1.350	1.377	2.70	117	167	217	2.80	2.744	2.800	2.856	4.67	140	200	260
1.40	1.372	1.400	1.428	2.70	121	173	225	2.85	2.793	2.850	2.907	4.75	140	200	260
1.45	1.421	1.450	1.479	2.70	125	179	233	2.90	2.842	2.900	2.958	4.83	140	200	260
1.50	1.470	1.500	1.530	2.70	130	185	241	2.95	2.891	2.950	3.009	4.92	140	200	260
1.55	1.519	1.550	1.581	2.70	134	191	249	3.00	2.940	3.000	3.060	5.00	140	200	260
1.60	1.568	1.600	1.632	2.70	138	198	257	3.05	2.989	3.050	3.111	5.08	140	200	260
1.65	1.617	1.650	1.683	2.75	140	200	260	3.10	3.038	3.100	3.162	5.17	140	200	260
1.70	1.666	1.700	1.734	2.83	140	200	260	3.15	3.087	3.150	3.213	5.25	140	200	260
1.75	1.715	1.750	1.785	2.92	140	200	260	3.20	3.136	3.200	3.264	5.33	140	200	260
1.80	1.764	1.800	1.836	3.00	140	200	260	3.25	3.185	3.250	3.315	5.42	140	200	260
1.85	1.813	1.850	1.887	3.08	140	200	260	3.30	3.234	3.300	3.366	5.50	140	200	260
1.90	1.862	1.900	1.938	3.17	140	200	260	3.35	3.283	3.350	3.417	5.50	142	203	264
1.95	1.911	1.950	1.989	3.25	140	200	260	3.40	3.332	3.400	3.468	5.50	144	206	268
2.00	1.960	2.000	2.040	3.33	140	200	260	3.45	3.381	3.450	3.519	5.50	146	209	272
2.05	2.009	2.050	2.091	3.42	140	200	260	3.50	3.430	3.500	3.570	5.50	148	212	276
2.10	2.058	2.100	2.142	3.50	140	200	260	3.55	3.479	3.550	3.621	5.50	151	215	280
2.15	2.107	2.150	2.193	3.58	140	200	260	3.60	3.528	3.600	3.672	5.50	153	218	284
2.20	2.156	2.200	2.244	3.67	140	200	260								

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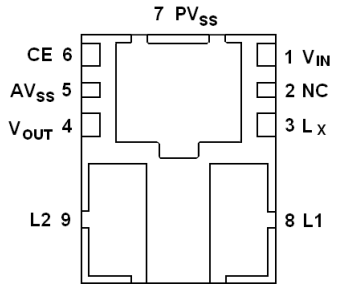
PIN CONFIGURATION

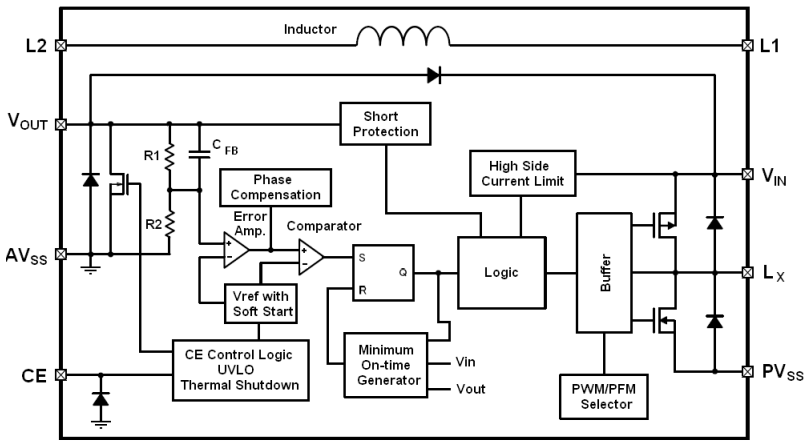


PIN ASSIGNMENT

PIN NUMBER	PIN NAME	FUNCTIONS
1	V_{IN}	Power Input
2	NC	No Connect
3	L_X	Switching Node
4	V_{OUT}	Fixed Output Voltage
5	AV_{SS}	Analog Ground
6	CE	Enable (Active HIGH); Do not leave this pin open
7	PV_{SS}	Power Ground
8	L1	Inductor Connection
9	L2	Inductor Connection

BLOCK DIAGRAM

IXD9213/14 Series



Internal diodes include an ESD protection and a parasitic diode

BASIC OPERATION

The IXD9213/14 series consists of a Reference Voltage source, Error Amplifier, PWM Comparator, Phase Compensation circuit, minimum on-time generator, output voltage resistive divider, P-channel switching transistor, N-channel transistor for the synchronous switch, Current Limiter circuit, UVLO circuit, and others. (See the block diagrams above.)

Device operates at a constant on-time mode, which features fast transient response and low output voltage ripple.

The Error Amplifier compares output voltage divided by internal resistors R_1/R_2 with the internal reference voltage. Amplified difference between these two signals applies to the one input of the PWM Comparator, while ramp voltage from minimum on-time generator applies to the second input. Resulting PWM pulse determines switching transistor ON time. It goes through the Buffer and it appears at the gate of the internal P-channel switching transistor. This continuous process stabilizes output voltage.

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The Current Feedback circuit monitors current of the P-channel transistor at each switching cycle, and modulates output signal from the Error Amplifier to provide additional feedback. This guarantees a stable converter operation even with low ESR ceramic load capacitor.

Reference Voltage Source

The Reference Voltage Source provides the reference voltage to ensure stable output voltage of the DC/DC converter. After CE pin activates IC, reference voltage connected to the error amp increases linearly during the soft-start interval. This allows the output voltage rise in proportion to the reference voltage. This operation prevents inrush current and allows the output voltage rise smoothly.
If the output voltage does not reach nominal output voltage within the soft start time due heavy load, or a large output capacitor, the current restriction function activates and prevents an excessive increase of the input current, allowing the output voltage to rise smoothly.

Minimum On-time Generator

The Minimum On-time Generator produces signal needed for PWM operation, and signals to synchronize all the internal circuits. The on time is set as function of the input and output voltages as $t_{ON} = V_{OUT}/V_{IN}$ *x 333* (ns).

Error Amplifier

The Error Amplifier monitors output voltage through resistive divider connected to V_{OUT} pin. If output voltage falls below preset value and Error Amplifier's input signal becomes less than internal reference voltage, the Error Amplifier/s output signal increases. That results in wider PWM pulse for switching transistor to increase output voltage. The gain and frequency characteristics of the error amplifier output are fixed internally to optimize IC performance.

Switching Frequency

The switching frequency is a function of the on time (t_{ON}), which is determined by the input voltage and output voltage, as given by the equation below.

$$f_{OSC}\ (MHz) = V_{OUT} / (V_{IN} \times t_{ON}\ (ns))$$

100% Duty Cycle Mode

When the load current is heavy and the voltage difference between input and output voltage is small, 100% duty cycle mode activates and it keeps the P-channel MOSFET in on-state. 100% duty cycle mode attains high output voltage stability and high-speed response under all load conditions, from light to heavy, even in conditions where the dropout voltage is low.

Current Limiter

The Current Limiter circuit monitors current flowing through the P-channel transistor connected to the Lx pin. When transistor's current is greater than a specified level, the Current Limiter turns off P-channel transistor immediately. After that, the Current Limiter turns off too, returning to monitoring mode.

The driver transistor turns on at the next cycle, but the Current Limiter will turn it off immediately, if an over- current exists. When the over current state is eliminated, the IC resumes its normal operation.

PWM/PFM Selection Circuit

PWM is a continuous conduction mode operation, and utilizes a stable switching frequency determined by on-time generator.
PWM/PFM auto switching mode allows utilize a discontinuous conduction mode at light loads, decreasing the switching frequency to reduce switching losses and improve efficiency, while returns to PWM mode and stable frequency at high load.
The IXD9213 series operate in PWM mode only, while the IXD9214 series operate in PWM/PFM auto switching mode.

UVLO Circuit

When the V_{IN} pin voltage becomes 2.0 V or lower, the P-channel transistor is forced OFF to prevent false pulse output caused by unstable operation of the internal circuitry. When the V_{IN} pin voltage becomes 2.10 V or higher, switching operations resume with the soft start. The soft start function operates even when the V_{IN} voltage falls below the UVLO threshold for a very short time. The UVLO circuit does not cause a complete shutdown of the IC, but causes pulse output to be suspended; therefore, the internal circuitry remains in operation.

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Thermal Shutdown

The thermal shutdown function monitors chip temperature to prevent IC damage, The thermal shutdown circuit starts operating and turns off both P- and N-channel MOSFETs, when the chip's temperature reaches 150^0C. When the temperature drops to 120^0C (TYP.) or less, the IC resumes normal operation through soft-start.

Short-Circuit Protection

The short-circuit protection monitors the output voltage. If output is accidentally shorted to the ground, output voltage starts falling. When this voltage becomes less than threshold level, the Short-Circuit Protection turns off and latches quickly the P-channel transistor.

To restart IC operation after this condition, either CE pin should be toggled H – L – H, or V_{IN} pin voltage should be set below UVLO to resume operations from soft start.

The sharp load transients creating a voltage drop at the V_{OUT} may result in Short Circuit protection operating at voltages higher than threshold level voltage.

C_L High Speed Discharge

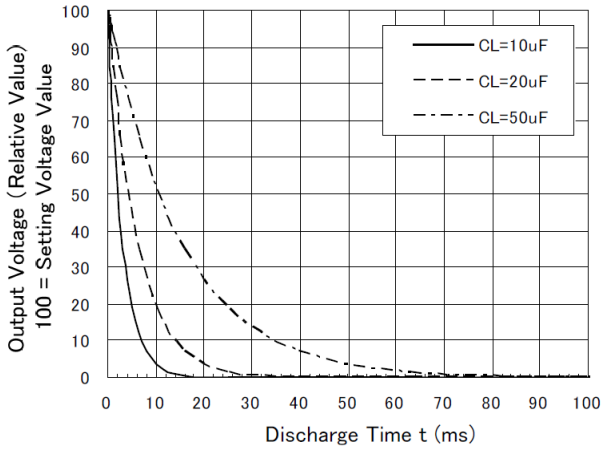
The IXD9213/02B, C, and G series can quickly discharge the output capacitor (C_L) to avoid application malfunction, when CE pin set logic LOW to disable IC.

C_L Discharge Time is proportional to the resistance (R) of the N-channel transistor located between the L_X pin and ground and the output C_L capacitance as shown below.

$$t_{DSH} = RC_L \times Ln\ (V_{OUT(E)} / V), \text{ where}$$

V - Output voltage after discharge
$V_{OUT(E)}$ - Output voltage
R = 300 Ω (Typical value)

Output Voltage Discharge Characteristics



CE Pin Function

The IXD9213/14 series enter the shut down mode, when a LOW logic-level signal applies to the CE pin. In the shutdown mode, IC current consumption is ~0.01 µA (Typical value), with the Lx and V_{OUT} pins at high impedance state. The IC starts its operation when a HIGH logic-level signal applies to the CE. The IC does not have pull-up/down resistors at CE input, therefore do not left this input open to avoid unstable IC operation.

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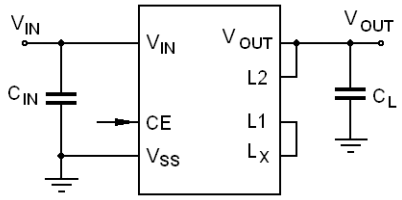
TYPICAL APPLICATION CIRCUIT

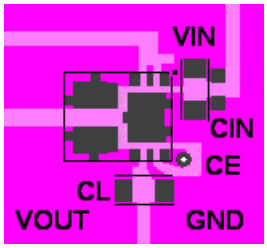


EXTERNAL COMPONENTS

C_{IN}, µF	10
C_L, µF	10

Capacitors should be X7R or X5R series to minimize power losses.

LAYOUT AND USE CONSIDERATIONS



1. Wire external components as close to the IC as possible and use thick, short connecting traces to reduce the circuit impedance. Please, pay special attention to the V_{IN} and GND wiring. Switching noise, which occurs from the GND, may cause the instability of the IC, so, position V_{IN} and V_{CL} capacitors as close to IC as possible (See recommended layout on the right).
2. Use ceramic capacitors of X7R or X5R type to minimize power losses.
3. Transitional voltage drops or voltage rising phenomenon could make the IC unstable, if ratings are exceeded.
4. At PWM mode, switching frequency may vary, depend on input/output voltage, load, external components value, and board layout. In addition, minimum on time generated may differ from calculated value due IC propagation delay and internal power losses.
5. If the difference between V_{IN} and V_{OUT} is small, IC generates very wide pulses, and there is a possibility that some cycles will be skipped completely at the heavy load current.
6. Inductor's rated current exceeds Current Limit threshold to avoid damage, which may occur until P-channel transistor turns off after Current Limiter activates, but pulse current may exceed this value.
7. Use of the IC at voltages below recommended voltage range may lead to instability.
8. In PWM/PFM automatic switching mode, if difference between input/output voltages is small and load is very low, inductor current may reverse decreasing IC efficiency.
9. If the output voltage remains below the short circuit protection threshold voltage at the end of the soft start, IC will stop operation.

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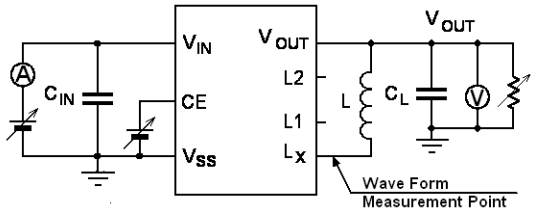
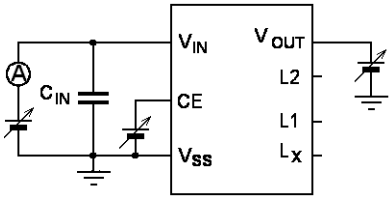
TEST CIRCUITS

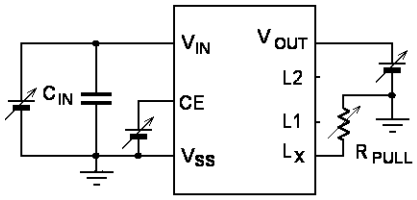
Circuit ①



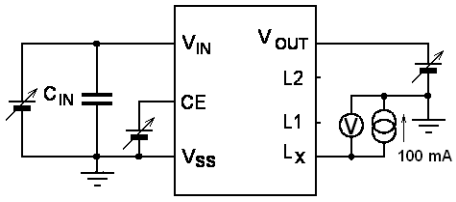
Circuit ②



Circuit ③

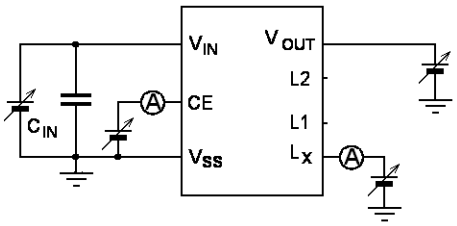


Circuit ④

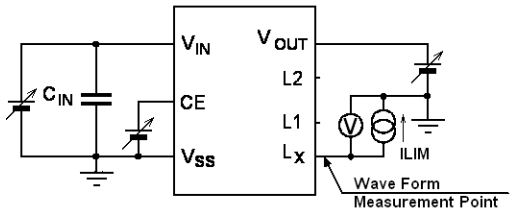


$R_{LXH} = (V_{IN} – V_{OUT}/100\ mA$, $R_{LXL} = V_{LX}/100\ mA$

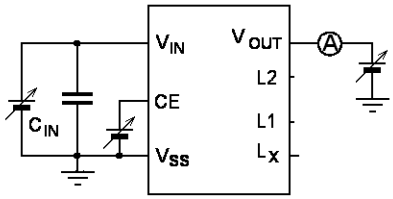
Circuit ⑤



Circuit ⑥



Circuit ⑦

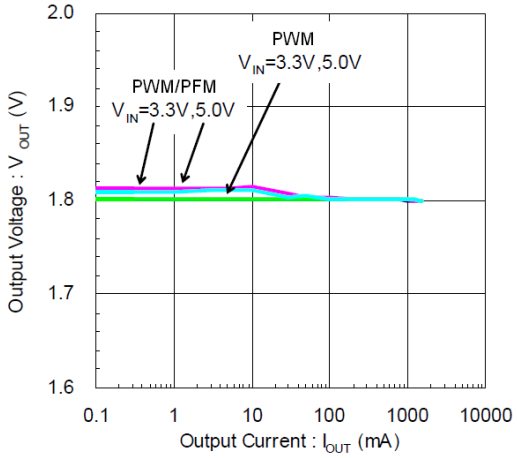


External Components
C_{IN} = 10 µF (ceramic), C_L = 10 µF (ceramic)
L = 1.0 µH
R_{PULL} = 200 Ω

TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current

IXD921xB183DR



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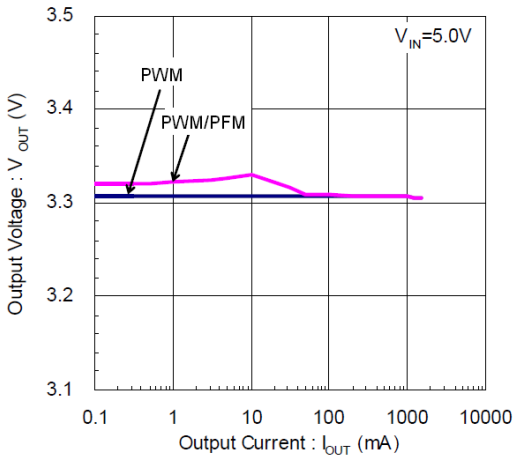
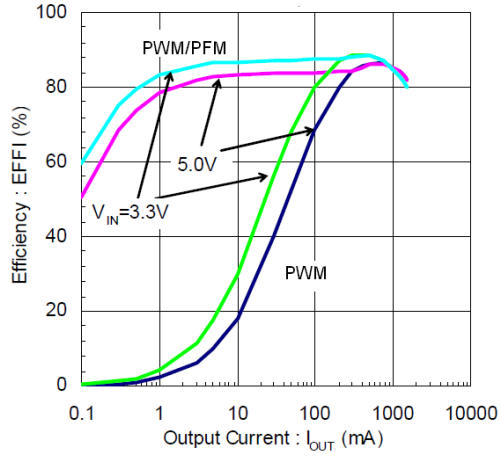


(2) Efficiency vs. Output Current

IXD921xB183DR



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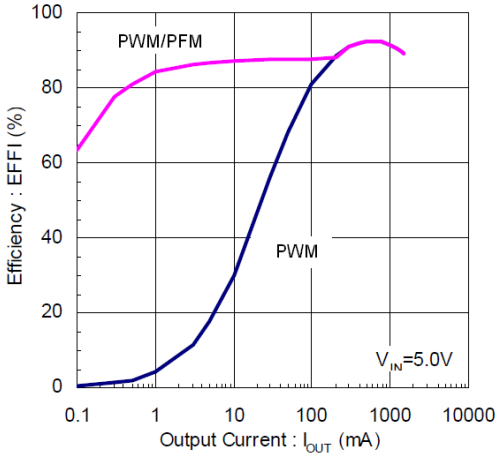
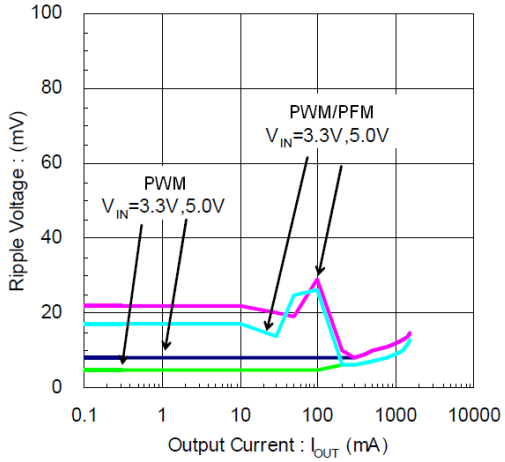


(3) Ripple Voltage vs. Output Current

IXD921xB183DR



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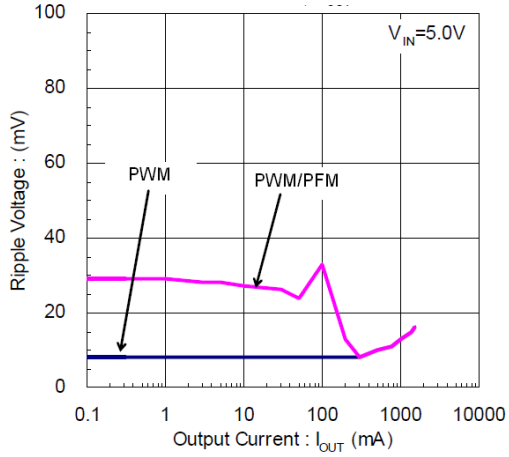

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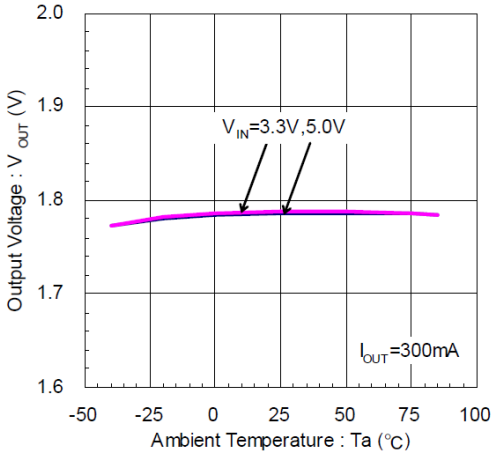
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(4) Output Voltage vs. Ambient Temperature

IXD921xB183DR



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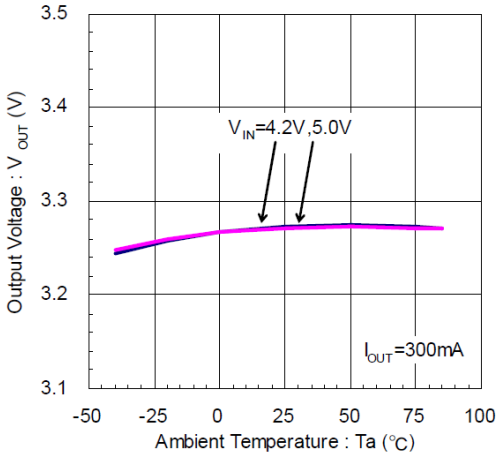
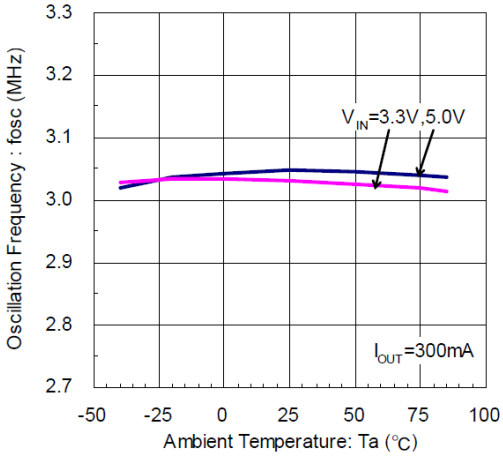
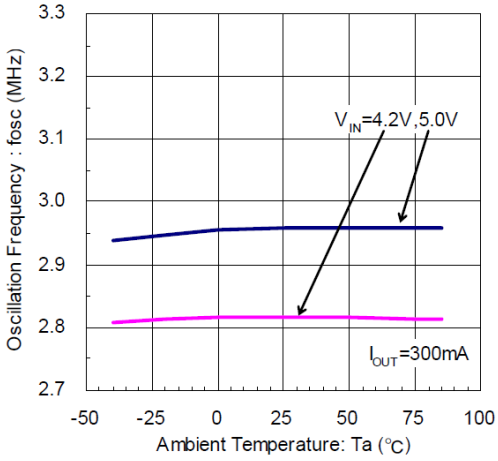


(5) Oscillation Frequency vs. Temperature

IXD921xB183DR

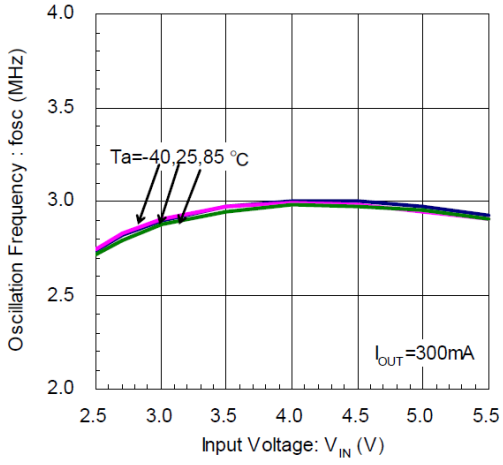


IXD921xB333DR

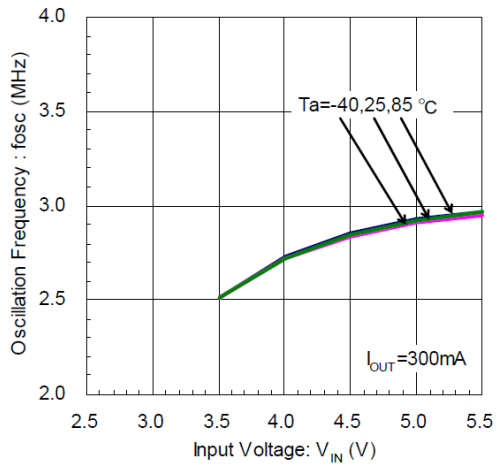


(6) Oscillation frequency vs. Input Voltage

IXD921xB183DR



IXD921xB333DR



(7) Load Transient Response

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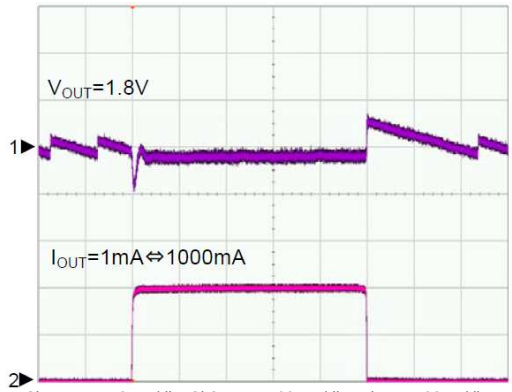
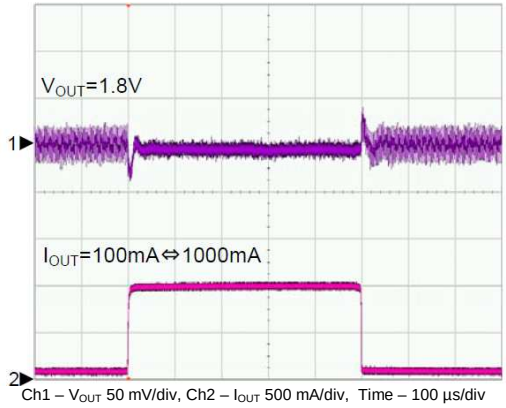
MODE: PWM/PFM Auto Switching

IXD9214B183DR



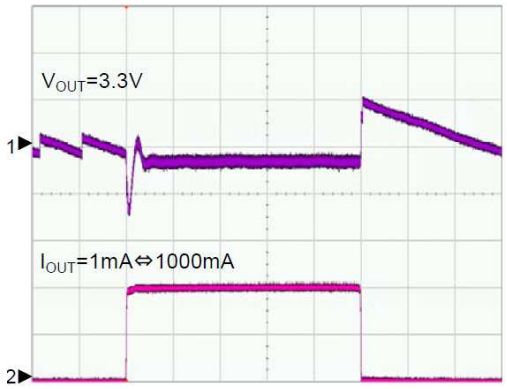
Ch1 – V_{OUT} 50 mV/div, Ch2 – I_{OUT} 500 mA/div, Time – 100 µs/div

IXD9214B183DR



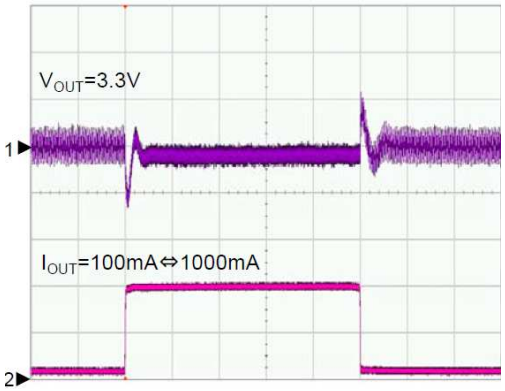
Ch1 – V_{OUT} 50 mV/div, Ch2 – I_{OUT} 500 mA/div, Time – 100 µs/div

IXD9214B333DR



Ch1 – V_{OUT} 50 mV/div, Ch2 – I_{OUT} 500 mA/div, Time – 100 µs/div

IXD9214B333DR



Ch1 – V_{OUT} 50 mV/div, Ch2 – I_{OUT} 500 mA/div, Time – 100 µs/div

ORDERING INFORMATION

IXD9213①②③④⑤⑥ PWM Mode only
IXD9214①②③④⑤⑥ PFM/PWM Mode auto switching

DESIGNATOR	DESCRIPTION	SYMBOL	DESCRIPTION
①	Type of DC/DC Controller	B	
②③	Fixed Output Voltage, V	08 - 36	② - Integer part, ③ - decimal part, i.e. V_{OUT} = 2.8 V - ② = 2, ③ = 8 For 0.05 V increment designator ③ values are: 0.05 = A, 0.15 = B, 0.25 = C, 0.35 = D, 0.45 = E, 0.55 = F, 0.65 = H, 0.75 = K, 0.85 = L, 0.95 = M V_{OUT} = 2,85 V - ② = 2, ③ = L
④	Oscillation Frequency	3	3.0 MHz
⑤⑥[1)]	Packages (Order Limit)	DR	USP-9B01 (3000/reel)

NOTE:

1) Reels are shipped in a moisture-proof packing.

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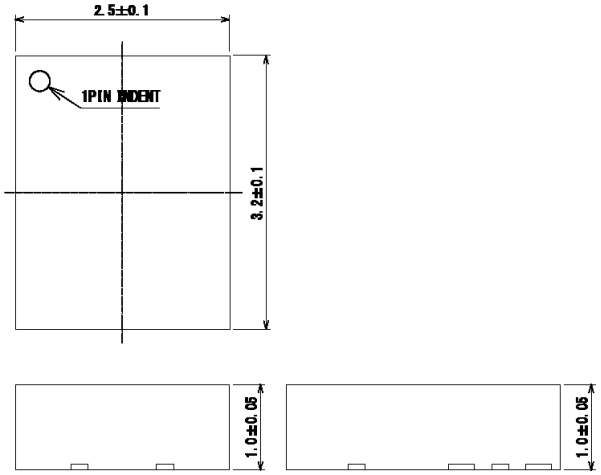
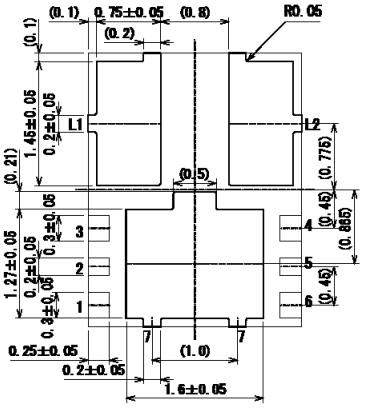
PACKAGE DRAWING AND DIMENSIONS

(Units: mm)

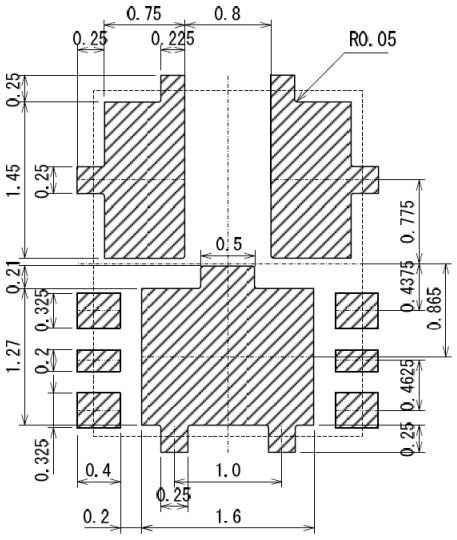
USP-9B01



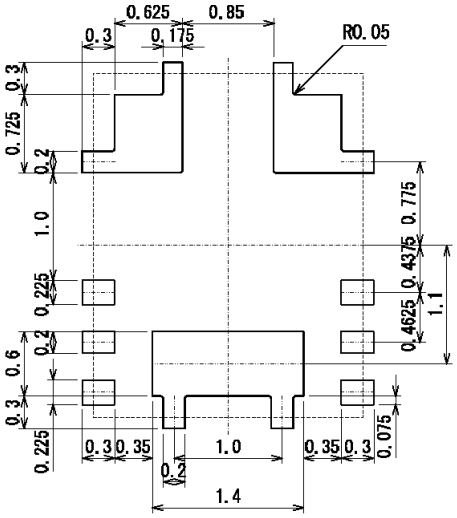
Bottom View



Reference Pattern Layout

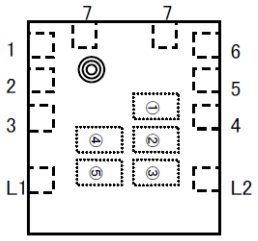


Reference Metal Mask Design



MARKING

USP-9B01



① Represents product series

MARK	PRODUCT SERIES
A	IXD9213Bxx3xx
B	IXD9214Bxx3xx

② Represents integral part of the voltage value

OUTPUT VOLTAGE, V	MARK
	IXD921xBxx3xx
0.x	A
1.x	B
2.x	C
3.x	D

③ Represents decimal part of the Voltage value

V_{OUT}, V	MARK
x.00	0
x.05	A
x.10	1
x.15	B
x.20	2
x.25	C
x.30	3
x.35	D
x.40	4
x.45	E
x.50	5
x.55	F
x.60	6
x.65	H
x.70	7
x.75	K
x.80	8
x.85	L
x.90	9
x.95	M

Example for marks②,③
V_{OUT} = 2.80 V – mark ② = 2, mark ③ = 8
V_{OUT} = 2.85 V – mark ② = 2, mark ③ = L

④⑤ Represents production lot number
01～09、0A～0Z、11～9Z、A1～A9、AA～AZ、B1～ZZ in order
(G, I, J, O, Q, and W excluded)

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